

PATENT
Docket No.: ACT-377

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Group Art Unit: 2811

Examiner: Donghee Kang

Serial No.: 10/625,490

Filed: July 22, 2003

In re Application of: Issaq et al.

Title: SWITCHING RATIO AND ON-STATE RESISTANCE OF AN ANTIFUSE
PROGRAMMED BELOW 5 mA AND HAVING A Ta OR TaN BARRIER
METAL LAYER

SUPPLEMENTAL DECLARATION OF FRANK HAWLEY

I, Frank Hawley hereby declare and state as follows:

1. I am employed as chief engineer by Actel Corporation, assignee of the present invention. I have been so employed for over fourteen years. I have been employed in the semiconductor industry in the field of process engineering for over twenty-five years. Because of my experience, I consider myself to be a person of ordinary skill in the semiconductor processing art.

2. I am one of the named inventors of the subject matter claimed in the instant application. I am also a named inventor of the subject matter disclosed in United States Patent No. 6,437,365, cited as a prior-art reference against the claims in the instant

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application. I am familiar with the contents of both the instant application and my prior-art patent.

3. As I stated in my previous Declaration of record in this application, the use of the particular combination of materials recited in the pending claims results in an antifuse having unexpectedly superior properties that are not inherent in prior-art antifuses. An antifuse formed as recited in the pending claims has significant unobvious and superior properties when compared with prior-art antifuses. First, such an antifuse is more reliable because it does not switch (i.e. revert back to its unprogrammed state) as do prior-art antifuses such as are disclosed in my prior patent. This is a critically important property for use in a product. Second, the antifuse as claimed in the pending claims of the instant application programs using a current of only about 1 mA, as opposed to the prior-art antifuses which require currents on the order of between about 5-25 mA to program. The significantly lower programming current of the antifuse of the present invention enables the design of a smaller product because the programming transistors can be made using smaller geometries. These properties are not inherent in the antifuses disclosed in the prior art.

4. I have read and understood the disclosure in United States Patent 6,107,165 to Jain et al. I have fabricated antifuses using the same set of materials as disclosed in the Jain et al. patent. These antifuses all program using currents in the range of 10-15mA,

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currents that are ten to fifteen times larger than the 1mA currents used to program the claimed antifuses. In addition, the programming voltages used to program the claimed antifuses are in the range of 5V, significantly less than the voltages (disclosed at col. 4 line 66 through col. 5, line 5 of Jain et al.) that must be used to program the antifuses disclosed in the Jain et al patent.

5. I have read and understood the disclosure in United States Patent 6,114,714 to Gangopadhyay. I personally worked with the inventor Shubhra Gangopadhyay on the antifuses disclosed in United States Patent 6,114,714. At Actel, I tested the devices disclosed in United States Patent 6,114,714 that were fabricated by Shubhra Gangopadhyay and brought to Actel. These devices did not perform as represented in the disclosure of United States Patent 6,114,714. These antifuses adhered very poorly, if at all, to the substrates on which they were fabricated. Many of the antifuse structures fell off of the substrates when the edges of the substrates were tapped against a table surface. Other ones of the structures fell off of the substrates when they were contacted with testing probes using standard test procedures. In addition, I worked at a project at Actel where we fabricated the antifuses disclosed in United States Patent 6,114,714 having more complex geometries than the ones brought to Actel by Shubhra Gangopadhyay. These antifuses had equally poor to non-existent substrate adhesion. Because the adhesion of these antifuse structures to substrates was extremely poor to non-existent, it is my opinion

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that the antifuses disclosed in United States Patent 6,114,714 are inoperative because they cannot be successfully fabricated.

6. The programming parameter properties of the antifuse as recited in the pending claims are clearly not inherent in the prior art. These properties are very advantageous and are unexpected. These properties are not suggested by any of the prior art antifuses that can be successfully fabricated to produce a useable antifuse. The antifuses of the present invention allow for a smaller and more reliable product, which thus has a much greater value and utility than products employing prior-art antifuses.

I, the undersigned, declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing therefrom.

Date:

July 22, 2008Frank Hawley
Frank Hawley